

WHAT IS CLAIMED IS:

1. A thermoplastic elastomer composition that is made by a process comprising: (1) mixing (A) a block copolymer comprising a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is comprised of repeat units that are derived from a conjugated diolefin monomer, wherein the repeat units in the second block are hydrogenated, and wherein the repeat units in the second block are elastomeric in nature, (B) a crosslinkable elastomer, and (C) an oil, to produce an un-crosslinked three component blend; and (2) dynamically crosslinking the crosslinkable elastomer in the un-crosslinked three component blend during a thermo-mechanical mixing step; wherein the thermoplastic elastomer composition is void of thermoplastic resins.
2. A thermoplastic elastomer composition as specified in claim 1 wherein the oil is present at a level which is within the range of about 10 to about 700 parts by weight per 100 parts by weight of the block copolymer.
3. A thermoplastic elastomer composition as specified in claim 1 wherein at least about 90% of the double bonds in the repeat units in the second block are hydrogenated.
4. A thermoplastic elastomer composition as specified in claim 1 wherein the block copolymer is selected from the group consisting of styrene-ethylene, butylene-styrene block copolymers, styrene-ethylene, propylene-styrene block copolymers, styrene-ethylene, propylene block copolymers, styrene-ethylene, ethylene propylene-styrene block copolymers, partially hydrogenated products of styrene-isoprene, butadiene-styrene block copolymers, styrene-butadiene-styrene block copolymers, and styrene-isoprene-styrene block copolymers.
5. A thermoplastic elastomer composition as specified in claim 1 wherein the oil is an extender oil selected from the group consisting of paraffinic oils, naphthenic oils, and polybutene.

6. A thermoplastic elastomer composition as specified in claim 1 wherein the block copolymer is a styrene-ethylene, butylene-styrene triblock polymer, wherein the ethylene, butylene block is obtained by the hydrogenation of a butadiene mid block with a vinyl content of no less than 30 percent by weight.

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7. A thermoplastic elastomer composition as specified in claim 1 wherein the block copolymer has a weight average molecular weight of at least 100,000.

8. A thermoplastic elastomer composition as specified in claim 1 wherein  
10 the crosslinkable elastomer is comprised of repeat units that are derived from conjugated diene monomers selected from the group consisting of 1,3-butadiene and isoprene.

9. A thermoplastic elastomer composition as specified in claim 1 wherein  
15 the crosslinkable elastomer is comprised of repeat units that are derived from 1,3-butadiene, isoprene, and a vinyl aromatic monomer, wherein the repeat units in the crosslinkable elastomer are distributed in a random manner, and wherein the crosslinkable elastomer is coupled with a tin coupling agent or a silica coupling agent.

10. A thermoplastic elastomer composition as specified in claim 1 wherein  
20 the crosslinkable elastomer is a styrene-butadiene rubber having a bound styrene content that is within the range of 5% to 40% by weight and the vinyl content that is within the range of about 5% to 80% by weight.

11. A thermoplastic elastomer composition as specified in claim 1 wherein  
25 the crosslinkable elastomer is a member selected from ethylene-propylene-diene rubber, ethylene-propylene rubber, butyl rubber, halobutyl rubber, halogenated rubbery copolymers of p-alkylstyrene and at least one isomonoolefin having 4 to 7 carbon atoms, nitrile rubber, styrene-acrylate-acrylonitrile rubber, hydrogenated nitrile rubber, acrylate rubber, ethylene-acrylate-glycidyl methacrylate elastomer, partially hydrogenated  
30 styrene-butadiene rubber, polyamide elastomer, polyester elastomer, natural rubber, polyurethane elastomer, chlorinated polyethylene, polychloroprene elastomer, chlorosulfonyl polyethylene elastomer, ethylene butyl acrylate copolymer, ethylene ethyl acrylate copolymer, ethylene vinyl acetate copolymer, polysulfide rubber, silicone

rubber, and a polyolefin copolymeric elastomer having at least two repeat units that are derived from the group consisting of ethylene, propylene, butene, hexene, and octene.

12. A thermoplastic elastomer composition as specified in claim 1 wherein  
5 the crosslinkable elastomer is a functionalized elastomer, wherein the functional groups are selected from the group consisting of epoxide groups, carboxyl groups, anhydride groups, glycidyl methacrylate groups, hydroxyl groups, and amine groups.

13. A thermoplastic elastomer composition as specified in claim 1 wherein  
10 the crosslinkable elastomer is crosslinked with a phenolic curing system.

14. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is crosslinked with sulfur.

15. A thermoplastic elastomer composition as specified in claim 1 wherein  
15 the crosslinkable elastomer is crosslinked with a peroxide curing system.

16. A thermoplastic elastomer composition as specified in claim 1 wherein  
the crosslinkable elastomer is crosslinked with a hydrosilation curing system.

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17. A thermoplastic elastomer composition as specified in claim 1 wherein at least about 95% of the double bonds in the repeat units in the second block are hydrogenated.

18. A thermoplastic elastomer composition as specified in claim 1 wherein  
25 the crosslinkable elastomer is an ethylene-propylene-diene elastomer.

19. A thermoplastic elastomer composition as specified in claim 1 wherein  
the crosslinkable elastomer is an ethylene-acrylate terpolymer.

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20. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is an acrylic copolymer, wherein the acrylic copolymer is functionalized with a halogen.

21. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is a polyamide elastomer.

5           22. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is dynamically crosslinked with a metal fatty acid salt cure system.

10           23. A thermoplastic elastomer composition as specified in claim 16 wherein the hydrosilation cure system is comprised of a hydrosilation agent and a hydrosilation catalyst.

15           24. A thermoplastic elastomer composition as specified in claim 23 wherein the hydrosilation agent contains at least two silicon hydride (Si-H) groups per molecule and contains 0.003 to 2.0 weight percent of hydrogen bonded to silicon, and is selected from the group consisting of trimethylsiloxy terminated methylhydrosiloxane-dimethylsiloxane copolymers, hydride terminated polydimethylsiloxanes, hydride terminated methylhydrosiloxane-dimethylsiloxane copolymers, trimethylsiloxy terminated polymethylhydrosiloxanes, poly(dimethylhydrogensiloxy)silanes, 20 tetrakis(dimethylsiloxy)silanes, tetrakis(dimethylsiloxy)silane, methyl tris (dimethylsiloxy) silane, phenyl tris (dimethylsiloxy)silane, polymethylcyclotetrasiloxanes and silicon hydrides of methylsiloxanes or polymethyldi- and polymethylsiloxanes.

25           25. A thermoplastic elastomer composition as specified in claim 23 wherein the hydrosilation catalyst is selected from the group consisting of a platinum, platinum zero compounds complexed with compounds selected from carbon monoxide, fumarates, maleates, phosphines, divinyltetramethyldisiloxanes or 25 tetravinyltetramethylcyclisiloxanes, palladium, chloroplatinic acid, platinum chloride complexes in alcohols, and rhodium, that is complexed with a member selected from 30 divinyltetramethyldisiloxanes or polyvinylmethyldisiloxanes or cyclovinylmethylsiloxanes wherein additional divinylsiloxanes or polyvinylsiloxanes or polyvinylmethylcyclisiloxanes are present, wherein the catalyst or catalyst complexed compounds are incorporated on the block copolymer, crosslinkable elastomer, and/or oil,

and are preferably present from about 0.0015 to about 1 parts metal by weight of the crosslinkable elastomer

26. A thermoplastic elastomer composition as specified in claim 23 wherein  
5 the hydrosilation catalyst is added by incorporating onto an inert carrier selected from the group consisting of fumed silica, precipitated silica, talc, calcium carbonate, paraffinic oil, and carbon black.

27. A thermoplastic elastomer composition as specified in claim 26 wherein  
10 the inert carrier is present at a level which is within the range of 0.01 to 10 parts by weight per 100 parts by weight of the crosslinkable elastomer.

28. A thermoplastic elastomer composition as specified in claim 26, wherein  
15 said thermoplastic elastomer composition is in the form of pellets, and wherein the soft thermoplastic elastomer composition is pelletized as it is being discharged from the thermo-mechanical mixing step.

29. An article of manufacture that is comprised of a soft thermoplastic  
elastomer composition overmolded onto a hard substrate, such as a metal or  
20 thermoplastic resin, wherein the soft thermoplastic elastomer composition is made by a process comprising: (1) mixing (A) a block copolymer comprising a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is comprised of repeat units that are derived from a conjugated diolefin monomer, wherein the repeat units in the second block are hydrogenated, and  
25 wherein the repeat units in the second block are elastomeric in nature, (B) a crosslinkable elastomer, and (C) an oil, to produce an un-crosslinked three component blend; and (2) dynamically crosslinking the crosslinkable elastomer in the un-crosslinked three component blend during a thermo-mechanical mixing step; wherein the thermoplastic elastomer composition is void of thermoplastic resins.

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30. A process for manufacturing an article of manufacture that comprises (1) mixing (A) a block copolymer comprising a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is

comprised of repeat units that are derived from a conjugated diolefin monomer, wherein the repeat units in the second block are hydrogenated, and wherein the repeat units in the second block are elastomeric in nature, (B) a crosslinkable elastomer, and (C) an oil, to produce an un-crosslinked three component blend; (2) dynamically crosslinking the crosslinkable elastomer in the un-crosslinked three component blend during a thermo-mechanical mixing step; wherein the thermoplastic elastomer composition is void of thermoplastic resins; (3) pelletizing the soft thermoplastic elastomer composition as it is being discharged from the thermo-mechanical mixing step; and (4) overmolding the soft thermoplastic elastomer composition onto a hard substrate to produce the article of manufacture.

31. A thermoplastic elastomer composition as specified in claim 19 wherein a polyamide elastomer is grafted onto the ethylene-acrylate terpolymer.

32. A thermoplastic elastomer composition as specified in claim 19 wherein a block copolymer is grafted onto the ethylene-acrylate terpolymer, wherein the block copolymer is comprised of a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is comprised of repeat units that are derived from a conjugated diolefin monomer, wherein the repeat units in the second block are hydrogenated, and wherein the repeat units in the second block are elastomeric in nature.

33. A thermoplastic elastomer composition as specified in claim 21 wherein a block copolymer is grafted onto the polyamide elastomer, wherein the block copolymer is comprised of a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is comprised of repeat units that are derived from a conjugated diolefin monomer, wherein the repeat units in the second block are hydrogenated, and wherein the repeat units in the second block are elastomeric in nature.

34. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is a polyurethane elastomer.

35. A thermoplastic elastomer composition as specified in claim 34 wherein a block copolymer is grafted onto the polyurethane elastomer, wherein the block copolymer is comprised of a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is comprised of repeat units that are derived from a conjugated diolefin monomer, wherein the repeat units in the second block are hydrogenated, and wherein the repeat units in the second block are elastomeric in nature.

36. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is hydrogenated nitrile rubber.

37. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is hydrogenated nitrile rubber and is compatibilized with a polyamide elastomer.

38. A thermoplastic elastomer composition of claim 23 wherein the hydrosilation agent is tetrakis (dimethylhydrogensiloxy)silane.

39. A thermoplastic elastomer composition of claim 23 wherein the hydrosilation catalyst is a platinum zero compound that is complexed with carbon monoxide and polyvinylmethylcyclicsiloxanes to give a platinum carbonyl complex in cyclic methylvinylsiloxanes.

40. A thermoplastic elastomer composition as specified in claim 1 wherein the oil is present at a level which is within the range of about 50 to about 500 parts by weight per 100 parts by weight of the block copolymer.

41. A thermoplastic elastomer composition as specified in claim 1 wherein the oil is present at a level which is within the range of about 70 to about 400 parts by weight per 100 parts by weight of the block copolymer.

42. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is present at a level which is within the range of about 5 to

about 400 parts by weight per 100 parts by weight of the block copolymer.

43. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is present at a level which is within the range of about 15 to  
5 about 200 parts by weight per 100 parts by weight of the block copolymer.

44. A thermoplastic elastomer composition as specified in claim 1 wherein the crosslinkable elastomer is present at a level which is within the range of about 25 to  
10 about 120 parts by weight per 100 parts by weight of the block copolymer.

45. A thermoplastic elastomer composition that is made by a process comprising: (1) mixing (A) a block copolymer comprising a first polymeric block that is comprised of repeat units that are derived from a vinyl aromatic monomer and a second block that is comprised of polyisobutylene units (B) a crosslinkable elastomer, and (C)  
15 an oil, to produce an un-crosslinked three component blend; and (2) dynamically crosslinking the crosslinkable elastomer in the un-crosslinked three component blend during a thermo-mechanical mixing step; wherein the thermoplastic elastomer composition is void of thermoplastic resins.